Heat Shield for Extreme Entry Environment Technology (HEEET) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)

ANTICIPATED BENEFITS

To NASA funded missions:

• HEEET has the potential to result in 30 – 40% heatshield mass reduction, compared to CP for extreme entry environment missions • HEEET can enable entry trajectories that are currently not practical with a CP heat shield • HEEET is being developed with long term sustainability in mind, trying to avoid current challenges with CP

DETAILED DESCRIPTION

HEEET is developing an efficient and innovative Thermal Protection System that can protect science payloads during entry where the heating is 2 orders of magnitude higher than for Space Shuttle or Mars missions. The ablative thermal protection system as already been recommended for use by SMD in Discovery AO and will enable missions to Saturn, Venus and the Outer Planets.

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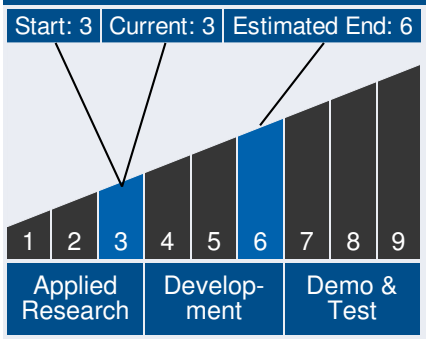
Technology Maturity



Management Team

Program Executive:

- Lanetra Tate

Program Manager:

- Mary Wusk

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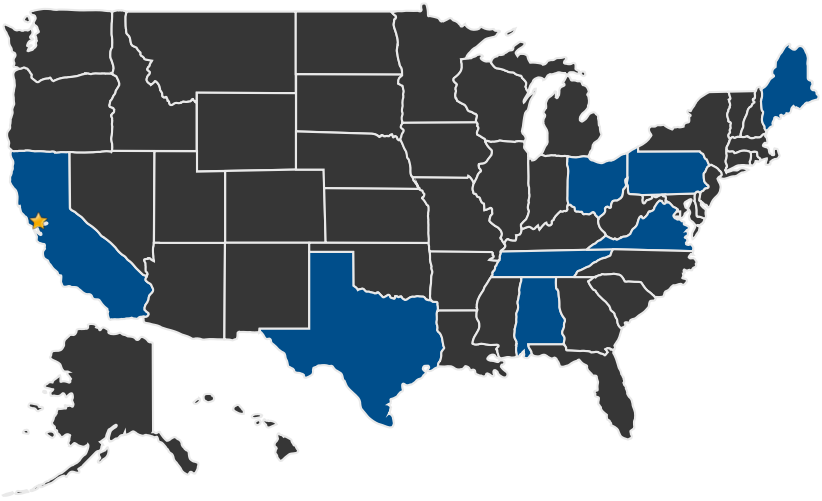
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Applied Aerospace Structures Corporation
- Bally Ribbon Mills
- Fiber Materials, Inc. (Biddeford, ME)

Management Team *(cont.)*

Project Manager:
- Ethiraj Venkatapathy

Principal Investigator:
- Michelle Munk

Co-Investigator:
- Ronald Chinnapongse

Technology Areas

Primary Technology Area:
Entry, Descent, and Landing Systems (TA 9)
- Aeroassist and Atmospheric Entry (TA 9.1)
  - Thermal Protection Systems for Rigid Decelerators (TA 9.1.1)
    - Extreme Environment Ablative Thermal Protection System (TPS) (TA 9.1.1.1)
    - Extreme Environment Ablative Thermal Protection System (TPS) (TA 9.1.1.1)

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Technology Areas *(cont.)*

Secondary Technology Area:
Entry, Descent, and Landing Systems (TA 9)
- Aeroassist and Atmospheric Entry (TA 9.1)
  - Thermal Protection Systems for Rigid Decelerators (TA 9.1.1)
    - Multifunctional, Micrometeoroid Orbital Debris (MMOD)-Tolerant Materials (TA 9.1.1.5)

Entry, Descent, and Landing Systems (TA 9)
- Aeroassist and Atmospheric Entry (TA 9.1)
  - Thermal Protection Systems for Rigid Decelerators (TA 9.1.1)
    - Multifunctional, Micrometeoroid Orbital Debris (MMOD)-Tolerant Materials (TA 9.1.1.5)
  - Deployable Hypersonic Decelerators (TA 9.1.4)
    - Mechanically-Deployed Entry Systems (TA 9.1.4.2)
    - Mechanically-Deployed Entry Systems (TA 9.1.4.2)

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Technology Areas *(cont.)*

Thermal Management Systems (TA 14)
- Thermal Protection Systems (TA 14.3)
  - Ascent/Entry TPS (TA 14.3.1)
    - Obsolescence-Driven Thermal Protection System Materials (TA 14.3.1.2)
    - Obsolescence-Driven Thermal Protection System Materials (TA 14.3.1.2)

DETAILS FOR TECHNOLOGY 1

Technology Title

Heat Shield for Extreme Entry Environment Technology (HEEET)

Technology Description

This technology is categorized as a material for unmanned spaceflight

The goal of the project is to mature woven TPS heatshield architectures to TRL 5/6 by 2017. The HEEET Woven TPS architecture consists of a high density all carbon surface layer (designed to manage recession) below which is a lower density layer composed of a blended CP yarn (insulating layer to manage heat load). This woven architecture is then infused with a mid-density level of phenolic resin. A layer-to-layer weave is typically utilized in HEEET, which mechanically interlocks the different layers together.

This dual-layer approach allows greater mass efficiency by limiting the thickness of the high-density outer layer. By varying the thicknesses of the different layers the mass can be optimized for a given mission. To date, the HEEET materials have been tested to conditions of ~5000 W/cm2 heat flux and five atmospheres of pressure and have shown excellent performance.

Capabilities Provided

A sustainable and tailorable heatshield TPS solution to enable extreme entry environment

missions

Potential Applications

Discovery and New Frontiers science missions (Venus probes and landers; Saturn and Uranus probes; and high speed sample return missions)